

Section 16 Fall Protection and Rope Supported Work

16.1 Fall Protection

Protect employees who work on slopes steeper than 1½:1, H:V slippery footing, or who could fall from heights of 6 feet or more (if not protected by fixed scaffolding, guardrails, or safety nets) by a personal fall protection system. The fall protection system must meet the requirements of this section. However, these requirements do not apply to rope supported work (high angle work) such as high scaling, geologic mapping, structural inspections, or other operations that require specialized rope equipment or techniques. Refer to the section on "Rope-Supported Work."

16.1.1 Hardware. Connectors must be drop forged, pressed, or formed steel or equivalent materials. Connectors must have a corrosion-resistant finish, and edges must be smooth to prevent damage to interfacing parts of the system. D-rings and snap-hooks must be able to sustain a minimum tensile load of 5,000 pounds (22.2 kilonewton [kn]). D-rings and snap-hooks must be proof-tested to a minimum tensile load of 3,600 pounds (16 kN) without cracking, breaking, or being permanently deformed.

a. **Snap-Hooks.** Snap-hooks must be of a locking type designed to prevent disengagement of the snap-hook by contact of the snap-hook keeper with the connected member.

b. **Use.** Connect snap-hooks to items 1-5 below only when designed for that use:

1. Directly to webbing, rope, wire rope, or chain.
2. To each other.
3. To a D-ring to that has another snap-hook or other connector is attached.
4. To a horizontal lifeline.
5. To any object with an incompatible shape or dimension that could disengage the snap-hook (e.g., the connected object depressing the snap-hook keeper and releasing itself).

16.1.2 Lanyards and Lifelines. Lanyards and vertical lifelines that tie off one employee must have a minimum breaking strength of 5,000 pounds (22.2 kN). Self-retracting lifelines and lanyards that automatically limit free fall distance to 2 feet (.61 meter [m]) or less must have components that can sustain a minimum static load of 3,000 pounds (13.3 kn) applied to the device, with the lifeline or lanyard fully extended. Self-retracting lifelines and lanyards

that do not limit free fall distance to 2 feet (.61 m) or less, ripstitch lanyards, and tearing and deforming lanyards must be able to sustain a minimum tensile load of 5,000 pounds (22.2 kN), applied to the device with the lifeline or lanyard fully extended. A qualified person must design, install, and supervise the use of horizontal lifelines, as part of a complete personal fall arrest system that maintains a safety factor of at least two. Restraint lines must be able to sustain a tensile load of at least 3,000 pounds (13.3 kN). Lifelines and carriers must not be made of natural fiber rope.

16.1.3 Anchorages. Anchorages must be able to support at least 5,000 pounds (22.2 kN) per employee attached, or must be designed, installed, and used under the supervision of a qualified person as part of a complete fall protection system that maintains a safety factor of at least two.

- a. **Rebar.** Anchorages may not be made from drill steel or reinforcing bar.
- b. **Mobile Anchorages.** Anchorages must not be made to mobile equipment or other items that can move while the anchorage is in use.

16.1.4 Procedures. Use personal fall protection systems and their components only for employee fall protection. Inspect lifelines, lanyards, belts, hardware, and anchorages before use each day and discard questionable devices. Use and care for fiber lifelines and lanyards according to recommendations contained in the *Rigging Manual* and in these standards, whichever is more protective.

- a. **Lifelines.** Provide each employee with a separate lifeline when using vertical lifelines.
- b. **Rescue.** Make provisions to promptly rescue employees who fall or provide the means for self-rescue.
- c. **Protection.** Protect lifelines from cut, abraded, or damaged in any way.
- d. **Maintenance, Inspection, Testing.** All personal fall protection systems must follow the manufacturers' recommendations for maintenance, inspection, and testing.
- e. **Training.** Before using personal fall protection systems, and after changing any component or system, train employees in the application limits of the equipment, proper hookup, anchoring, and tie-off techniques, methods of use, and proper methods of equipment inspection and storage.

16.1.5 Personal Fall Arrest System. A system used to arrest an employee in a fall from a working level consists of an anchorage, connectors, and a body harness. The system may also include a lanyard, deceleration device, lifeline, or suitable combination of these.

- a. **Performance Criteria.** Personal fall arrest systems must, when stopping a fall:
 1. Limit maximum arresting force on an employee to 1,800 pounds (8 kN), when used with a body harness.
 2. Bring an employee to a complete stop and limit the maximum deceleration distance an employee travels to 3.5 feet (1.07 m).
 3. Have sufficient strength to withstand twice the potential impact energy of an employee freefalling a distance of 6 feet (1.8 m), or the free fall distance permitted by the system, whichever is less.
- b. **Performance Test.** When used by employees with a combined person and tool weight of less than 310 pounds (140 kg), personal fall arrest systems meeting the criteria and protocol contained in 29 CFR 1926 Subpart M, must comply with these requirements.
- c. **Use.** Rig personal fall arrest systems to prevent an employee from falling more than 6 feet or contacting any lower level. Employees must wear a personal fall arrest system with the attachment point of the body harness in the center of the back near shoulder level or above the head. When connected to a horizontal lifeline that could become vertical, connectors must be able to lock in either direction on the lifeline.
- d. **Maintenance.** Maintenance is a critical element in personal fall arrest systems. Follow manufacturer's recommendations. At least one employee, certified and trained by the manufacturer as qualified to inspect and maintain personal fall arrest systems, must be available when such systems are in use.
- e. **Impact Loading.** When a personal fall arrest system has been subjected to shock loading, immediately remove it from service until a qualified person inspects it and determines it suitable for reuse.

16.1.6 Positioning Device System. Positioning device systems include equipment or hardware that, when used with its body belt or body harness, supports an employee on an elevated vertical surface (such as a wall or a rebar mat), allowing both hands freedom of movement. Such systems also refer to devices attached between the employee and an anchorage to prevent an accidental fall from an elevated surface.

a. **Performance Criteria.** Positioning device systems must withstand, without failure, a 4-foot (1.2-m) drop of a 250 pound (113-kg) weight.

b. **Performance Test.** Positioning device systems comply with these requirements if they meet the test contained in 29 CFR 1926 subpart M, appendix D. Restraint line systems must be designed to meet the same test requirements as other positioning device systems.

16.1.7 Personal Fall Protection System for Ladder Climbing. Employees wear, or are attached to, personal fall protection systems to prevent injuries and falls.

a. **Design Criteria for System Components.** The system must permit the employee to ascend or descend with both hands free for climbing, without having to hold, push, or pull any part of the system. The connection between the carrier or lifeline and the point of attachment to the body belt or harness must be no more than 9 inches (23 cm) long. The system must activate within 2 feet (0.61 m) after a fall occurs to limit the descending velocity of an employee to 7 feet per second (2.1 meters per second) or less.

b. **Performance Criteria.** Ladder safety devices and their support systems must withstand, without failure, an 18-inch (0.41-m) drop of a 500-pound (226-kg) weight. All other personal fall protection systems for climbing activities must withstand, without failure, a 4-foot (1.2-m) drop of a 250-pound (113-kg) weight.

c. **Installation.** Attach mountings for rigid carriers at each end of the carrier. Attach intermediate mounting, as necessary, spaced along the entire length of the carrier to provide the strength necessary to stop employee falls. Attach mounting for flexible carriers at each end of the carrier. When the system is exposed to wind, install cable guides used with a flexible carrier with a minimum spacing of 25 feet (7.6 m) and a maximum spacing of 40 feet (12.2 m) along the entire length of the carrier, to prevent wind damage to the system. The design and installation of mountings and cable guides must not reduce the design strength of the ladder.

16.1.8 Requirements for Linemen's Belts and Lifelines

a. **Belt and Lifeline Requirements.** Use linemen's body belts and safety straps when working above ground levels on wood poles, steel towers, communication towers, and other transmission line, substation, and switchyard structures.

b. **Body Belts, Safety Straps, and Lanyards.** Linemen's body belts, safety straps, and lanyards must meet the current design specifications in 29 CFR 1926.959. The manufacturer must certify compliance.

c. **Nonconductive Rope Lifelines.** Nonconductive rope lifelines must have a minimum breaking strength of 5,000 pounds and be able to withstand an alternating current dielectric test of at least 25,000 volts per foot "dry" for 3 minutes without visible deterioration.

16.2 Rope Supported Safety Requirements

The requirements in this section apply when an employee performs rope-supported work on high angle slopes, where the rope is the primary means of support, and where the employee must manipulate the rope and its attachments, while using technical climbing techniques to obtain access to the work area. This includes such work as high scaling, geologic mapping, rock bolting, structural inspections, construction, operations, and maintenance activities. Permit rope-supported work only when other means of access are not feasible or methods other than rope-supported work expose employees to greater danger.

16.2.1 **Belays.** Use a safety (belay) rope for work covered by this section. The belay line must be separate and independent from the support (load) line. Another employee may control the belay or the belay may be self-controlled. Use a belay line, if feasible, for jobs where the work surface provides the primary support once the work site is reached. The standard belay line (safety line) must be a dynamic rope that meets the minimum strength requirements of this section. When not using a standard belay, use a deceleration device to limit fall forces to less than 1,800 pounds. The maximum free fall distance must not exceed 6 feet.

16.2.2 **Equipment.** The employee who performs the inspection must know how the entire system will function under various slope conditions. Equipment strengths must be certified, listed as meeting, or shown by testing to meet the requirements of ANSI A10.14, ANSI Z359.1, the European Union (designated by the "CE" marking), Union Internationale des Associations d'Alpinisme (UIAA), or other recognized certification organization. Knots, friction devices, ascenders, and other hardware will decrease the overall strength of the rope support system. Before use, evaluate the complete support system, with all of its parts, for adequacy.

16.2.3 **Anchorage.** Use at least two independent anchorages. Each anchorage must be able to support at least 5,000 pounds (22.2 kN) static load. Locate anchorages far enough apart so that failure of one anchor will not cause failure of another anchor. If possible, locate anchors in line with the direction of rope pull; otherwise, take steps to limit the rope extension if one anchor fails. All climber-installed anchorages, except directional anchors, must meet the minimum strength requirements of this section. Directional anchors are anchors used to laterally position a climber who is supported by two anchors meeting the requirements of this section. Directional anchors do not take the place of the main support anchors.

16.2.4 Rope. Support or safety ropes must be manmade fiber ropes, specifically designed for climbing or rescue applications and must be capable of supporting 5,000 pounds (22.2 kN) static load without failure. Ropes must be of kernmantle construction with a minimum diameter of 7/16 inch (11 mm) and a maximum diameter of ½ inch (13 mm).

16.2.5 Hardware. All connecting hardware used in the support system must be capable of supporting 5,000 pounds (22.2 kN) static load without failure. Use only locking carabineers in the support system. You may substitute locking shackles for locking carabineers in anchor connections.

16.2.6 Body Harnesses. Use only full body harnesses, which distribute fall arrest forces over at least the upper thighs, pelvis, waist, chest and shoulders. Harness connections must be designed for work positioning and fall arrests and be capable of supporting 5,000 pounds (22.2 kN) static load without failure. Separate waist and chest harnesses are permitted if designed to be buckled together.

16.2.7 Equipment Inspection. Inspect all equipment used for rope-supported work before and after each use, using the manufacturer's recommended procedures. Maintain a rope log for each rope.

16.2.8 Equipment Retirement. If any equipment used for rope-supported work is subjected to severe impact or shock loading, immediately remove it from service. Do not use it for employee protection until it has been inspected and determined suitable for reuse. The employee who inspects the equipment must be knowledgeable about equipment specifications. Remove from service any equipment that exceeds manufacturer's recommended wear or shows other defects. Automatically retire ropes, webbing, accessory cord, and harnesses from service after 5 years, regardless of condition or use history.

16.2.9 Training. Train employees in the techniques and equipment used for rope-supported work before assigning them to a job where its use is required. The training must cover climbing safety and hazards; the use, limitations, inspection and maintenance of equipment; and basic climbing and self rescue techniques. Only the following individuals may conduct training courses for Reclamation employees: (1) a Reclamation climbing certifier, (2) a Reclamation employee designated by a Reclamation climbing certifier as competent to train personnel in using rope-supported work equipment and procedures, or (3) a training contractor certified by a Reclamation climbing certifier as competent to train personnel in using rope-supported work equipment and procedures. Contractors must provide training to their employees to make sure they meet the minimum skills requirements of this section.

Reclamation employees' minimum standards must meet the following for basic training and experience:

a. **Climber.** A climber must have at least 32 hours of basic climbing training. Basic training must include:

- Climbing safety and fall hazards
- Applications of equipment
- Estimating free fall distance
- Anchorage techniques
- Equipment maintenance and inspection
- Rescue
- Practice in applying techniques outlined in the Reclamation rope-supported work guidelines.

A climber must complete 32 hours of developmental training each year. However, this requirement can be reduced to 16 hours annually if the climber has at least 40 hours of on-rope work experience during the year.

b. **Team Leader.** The team leader must be a certified climber, have the ability to write a job hazard analysis, be able to analyze and lay out rope-supported jobs safely and efficiently, have experience in the type of work to be performed, and be able to verify the climbing team's experience and physical qualifications. A team leader is responsible for and will supervise, either directly or indirectly through an acting team leader, all climbing operations conducted by his/her team. A team leader must complete 32 hours of developmental training each year. This requirement can be reduced to 16 hours annually if the team leader has at least 40 hours of on-rope work experience during the year.

c. **Climbing Certifier.** A climbing certifier must be a certified climber and designated team leader or capable of fulfilling that role. The climbing certifier will be responsible for certifying Reclamation employees as climbers and team leaders, and will act as a resource person for climbing teams. Each year, the climbing certifier must complete the annual training required for a climber plus complete 16 hours of advanced developmental training and maintain an approved independent certification.

d. Basic climbing training must include an opportunity to practice the skills learned in progressively more difficult situations. Beginning climbers will continue on-the-job training under the team leader's close supervision following completion of basic training. Before starting any job, provide refresher practice or developmental training, as needed. Document all training.

16.2.10 **Certification.** After completing basic climbing training and before being certified for rope-supported work, Reclamation employees must pass a certification test. The certification test must include a written exam and opportunity to demonstrate basic technical skills. A Reclamation climbing certifier must conduct the certification test. Certification will

be valid for 1 year, and the team leader will renew certification upon successful completion of the minimum annual developmental training. Certification will remain valid only if a climber completes the annual minimum developmental training requirement.

- a. At least every 3 years, the team leader and a climbing certifier, who has not climbed with the climber being evaluated or the team leader in the preceding year will evaluate the experience and overall skill level of each certified climber. If the climber's skill is found to be inadequate, the climber must retake the basic certification training course or complete a focused training course designated by the team leader, or, at the discretion of the team leader, will not be re-certified.
- b. Each climber must maintain a personal log of climbing and training activities to aid in recertification and training review.

16.2.11 Physicals. Certified climbers must successfully complete a medical examination annually and be cleared to perform rope-supported work. The team leader will remove any climber from the climbing team for failing to meet the medical qualification criteria.

16.2.12 Climbing Team. A climbing team consisting of at least three certified climbers will perform rope-supported work.

16.2.13 Team Leader. Appoint a team leader for each activity requiring rope-supported work. The team leader must be a qualified individual and will have overall responsibility for the coordination and conduct of the rope-supported work activity.

16.2.14 Top Person. A lookout (top person) must be on duty at the anchor points of the support (load) lines and belay (safety) lines at all times when employees are working on ropes. The top person's duty will be to ensure that anchorages remain secure and undisturbed and that no activities take place that could endanger employees working on the ropes. The top person must also help respond to emergency situations.

16.2.15 Communications. Maintain reliable voice communications between an employee on the rope and the top slope or belay personnel. If distance or background noise interferes with voice communications, use a two-way radio.

16.2.16 Rescue. Before starting rope-supported work, make arrangements for rescue. Provisions for rescue must include self-rescue, rescue using on-site personnel, and rescue requiring off-site personnel.

16.2.17 Job Planning. Before starting a job requiring rope-supported work, submit a Job Hazard Analysis (JHA) to the Contracting Officer's Representative (COR) or the appropriate office head. A person qualified in rope-supported work (high angle work) must review the

JHA before submitting it to the appropriate office heads. The JHA must address, at a minimum, the following items:

- a. Emergency procedures, including medical assistance.
- b. Personal protective equipment required, including gloves, safety glasses, hard hat with chin strap, foul weather gear, etc. Use climber safety helmets certified by UIAA/CE for rope-supported work if they offer equal or greater protection than ANSI Z89.1 type II hard hats.
- c. Describe the equipment to be used for rope-supported work. For example, type and sizes of rope to be used, hardware, types of anchorages, and auxiliary equipment.
- d. Methods for ensuring safe entrance and exit from slope.
- e. Instruction and/or refresher training sessions (as required) to ensure competency and knowledge of requirements for all employees performing rope-supported work.
- f. Procedures for protecting employees and public from falling material.
- g. Provisions for rescue, including both rescue by onsite personnel and arrangements for rescue services by offsite personnel.
- h. Other hazards, including confined spaces, hazardous energy, biohazards, chemical hazards, etc.